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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
08/581,347	12/29/1995	JAMES M. CLEEVES	16820.P121	6557

757 7590 08/27/2002

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ART UNIT	**PAPER NUMBER**
1645	20

DATE MAILED: 08/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

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BEFORE THE BOARD OF PATENT APPEALS

AND INTERFERENCES

Paper No. 30

Application Number: 08/581,347

Filing Date: December 29, 1995

Appellant(s): James Montagure Cleeves

Mr. Jonathan M. Blanchard, Ph.D

EXAMINER'S ANSWER

This is in response to the appeal brief filed December 6, 2001.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

The appellant's statement in the brief that certain claims do not stand or fall together is not agreed with because all of the claims are directed to a method of making a semiconductor structure

substantially uniform across the substrate, and produce the semiconductor structure utilizing materials and means known in the art of plasma etching.

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

The following is a listing of the prior art of record relied upon in the rejection of claims under appeal.

5,096,536	Cathey, Jr.	3-1992
5,089,880	Meyer et al.	2-1992
4,931,135	Horiuchi et al	6-1990

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 21-27, 29, 31-37, 40, 41-43 are rejected under 35 U.S.C. 102(b) as being anticipated by Cathey, Jr. (US Patent 5,096,536).

The claimed invention is directed to a method of making a semiconductor, the method comprising the steps of plasma etching a surface and transferring heat from the substrate to a seal on a support surface.

Cathey, Jr disclose a method and apparatus for plasma etching of semiconductor materials (title), wherein the substrate surface is etched with simultaneous heat transfer for improved semiconductor production.

a.(instant invention claim 21) The heat transfer is accomplished through the use of a ring seal (col. 2, lines 37) and helium gas heat transfer which fills the vacuum voids between the wafer and the supporting electrode (col. 2, lines 30-31 and col. 2, lines 62-67).

b.(instant invention claims 22,29,31-33,36-37 and 40) The incorporation of a holding body into the etching assembly provides means for supporting the substrate and has an aperture for passing therethrough helium gas which effects the heat transfer(col. 5, lines 3-5). The presence of the seal defines a space that affords for effective, substantially uniform heat transfer across the substrate because the gas is moved into the space and away from the substrate past the lower electrode so plasma etching a substrate results in an improved apparatus (col. 2, lines 62-68)

c. (Instant invention 23) Positioning and holding the substrate is accomplished through the use of a mechanical (col. 4, lines 16-30) or electrostatic clamping means(col. 6, lines 22-29).

d.(instant invention claim 24) The seal defines a distance between the wafers lower surface and the electrode of about 0.005 inches and therefore defines the seal with a thickness of approximately 125 microns (col. 4, lines 39-45).

e. (Instant invention claim 25 and 34)The seal is located at an outer peripheral portion with a shape that is in association with the outer peripheral portion of the substrate (labeled portion of figure #20). The O-ring type seals are taught to be used in combination with lip-type seals and any other seals of a suitable configuration (col. 6, lines 38-41).

f. (Instant invention claim 26 and 35) The use of first and second seals provides for a substantially airtight system (see figures and col. 5, lines 19-35).).

g.(instant invention claim 27) The seal width is defined as the cross section of the O-ring and has the dimension of about 2.5 to 6.35 mm (.1 to .25 inches) and therefore discloses range that encompass the now claimed width of approximately 3 to 4 mm. The reference inherently anticipates the now claimed invention.

Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cathey, Jr. as applied to claims 21-27, 29, 31-37, 40, 41-43, above, in view of Meyer et al (US Patent 5,089,880).

See discussion of Cathey above. Cathey teach the production of semiconductors in an improved temperature controlled system, wherein the system comprises the use of seals that provide for the uniform transfer of heat using helium gas, but differs from the instantly claimed invention by failing to show the thickness of the substrate upon which the semiconductor is made, specifically 25-125 microns.

Meyer et al disclose the use of a wafer substrate in the production of a semiconductor with a thickness of approximately 75-175 microns (col. 8, lines 64-67) in an analogous art for the purpose of making semiconductors in a pressurized interconnection system.

Therefore, it would have been obvious to the person of skill in the art at the time the invention was made to use a substrate of a thickness of about 75 microns in the method of Cathey because Meyer teaches that semiconductor substrates may have a thickness 75 microns and provided a surface upon which a semiconductor was successfully produced. The person of ordinary skill in the art would have been motivated by the reasonable expectation of success of using a substrate of 75 microns because the size substrate had been successfully used in the production of a semiconductor by Meyer. The person of ordinary skill in the art would have been motivated to utilize a substrate of a size that had been previously shown to successfully result in a semiconductor surface. Cathey, Jr in view of Meyer et al obviate claim 28.

Claims 21 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cathey as applied to claims 21-27, 29, 31-37, 40, 41-43, above in view of Horiuchi et al (US Pat. 4,931,135) .

See discussion of Cathey above. Cathey teach the use of a polymeric material in the production of the seal members but differs from the instantly claimed invention by failing to show the use of Kapton (also known as Capton and polyimide) as the polymeric material to make the seal.

Horiuchi et al show the use of polyimide in an analogous art for the purpose of producing an improved etched substrate (see col. 6, lines 23-30; col. 10, lines 33-46; abstract), wherein the improved etched substrate is obtained through locating the polyimide between the electrode and the semiconductor substrate mounting surface thus defining means for more uniform impedance between substrate and electrode, and more uniform heat transfer across the substrate surface. The polyimide defines means for greater temperature uniformity across the substrate during the etching process, which results in greater etched substrate uniformity.

It would have been obvious to the person of ordinary skill in the art at the time the invention was made, to modify the method of Cathey, Jr. to utilize a polyimide as taught by Horiuchi, in the method of making a semiconductor substrate, because Horiuchi et al teach that polyimide provides a means for transfer of heat from the substrate surface which results in increased substrate temperature uniformity and an improved etched substrate with greater uniformity. Therefore, the person of ordinary skill in the art at the time the invention was made would have been motivated by the reasonable expectation of success of obtaining a improved semiconductor etched substrate with greater uniformity utilizing a polyimide polymer because the polymer provides means for controlling

cooling gas pressure and a means for temperature uniformity of the substrate due to uniform transfer of heat across the bottom of the substrate bottom surface with the cooling gas (col. 10, lines 38-48).

Claims 38-39 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps. See MPEP § 2172.01. The omitted steps are: the specific materials and methods steps for making a semiconductor (claim 38, depends from claim 21), because the method of claim 21 only provides for the production of a single component part of a semiconductor, an etched substrate, and claim 39 recites steps for making an electronic device, but what components and the arrangement of the components are, in order to make the electronic device, are not distinctly claimed.

(11) Response to Argument

1. The rejection of claims 21-27, 29, 31-37, 40, 41-43 under 35 U.S.C. 102(b) as being anticipated by Cathey, Jr. (US Patent 5,096,536) is argued by asserting that Appellant's invention "alleviates the problem of uncontrollable or uneven semiconductor wafer etching by transferring heat substantially uniformly across a substrate."

2. It is the position of the examiner that the applied prior art discloses such a method (see Cathey, Jr., col. 1, lines 61-68 and col. 2, lines 1-3) . The etched semiconductor wafer is produced through transferring heat from the substrate, substantially uniformly across the substrate because the temperature of the substrate (wafer) is controlled (see Cathey Jr., col. 1, lines 58-67) through the application of helium gas which fills the vacuum voids (see Cathey, Jr. col. 2, lines 25-31 and col. 4,

lines 52-68). Cathey, Jr. teaches through the utilization of helium to fill vacuum voids, the transfer of heat across the substrate is more uniform (Cathey, Jr., col. 4, lines 52-68) and with "good cooling and heat transfer away from the wafer", the "rate of a photoresist polymer" " can be selectively controlled by controlling the temperature of the wafer being etched (see col. 1, lines 65-67)."

3. It is asserted by Appellant that the instantly claimed invention, differs from that of the prior art in that it is "directed to reducing temperature differences between portions of the substrate, not enhancing overall heat transfer from the substrate."

4. It is the position of the examiner that Cathey Jr. does disclose a method of "reducing temperature differences between portions of the substrate, as well as enhancing overall heat transfer from the substrate". The portions of the substrate that evidence differences in heat transfer because the electrode does not come in contact evenly across the substrate surface, is compensated for and results in uniform heat transfer through back cooling of the substrate with helium gas. The helium provides means for increased heat transfer, producing substantially uniform heat transfer across the substrate due to the uniform temperature of the etched substrate surface (see Cathey, Jr., col. 2, lines 13-16). Cathey, Jr. teaches that through utilization of a sole seal (single seal, see Cathey, Jr., col. 2, lines 35-45) together with a clamp, utilization of a clamp to form a seal between the wafer and the electrode (see Cathey, Jr, col. 2, lines 46-51) or a two seal system define means for substantially improving etched substrate characteristics (see Cathey, Jr. col. 2, lines 64-68, and col. 3, lines 1-9), and define means for solving the problem of temperature control. The improvement

being increased heat transfer substantially across the substrate surface due to the high vacuum voids that exist between the substrate wafer and the supporting electrode being essentially eliminated through the addition of helium to fill the void. Several types of seals are disclosed (see Cathey, Jr., col. 6, lines 38-40).

5. Appellant argues, with emphasis, the statement that the cited art "does not address, or even mention, the uniformity of heat transfer across a substrate."

6. It is the position of the examiner that Cathey, Jr., clearly teaches the concept of uniformity of heat transfer across the substrate, specifically in the statement "this cooling is necessary to prevent degradation of the etch mask as well as to consistently control polymer and inorganic depositions which determine profiles of the etched features (Cathey, Jr, col. 1, lines 61-64)" and "[U]nless these voids are filled with a good heat transfer gas such as helium, they produce poor heat transfer pockets between the wafer and supporting electrode and thereby prevent good wafer cooling as is required in theses types of plasma etching systems (see col. 4, lines 58-63)". Cathey, Jr teaches that with consist control of heat transfer of the substrate (wafer), through the elimination of "poor heat transfer pockets between the wafer and supporting electrode" (Cathey, Jr., col. 4, lines 52-68), the resulting etched semiconductor substrate is more uniform (see Cathey, Jr, col. 5, line 48), and the substrate will not have "undesirable and spurious reaction products" on its surface.

7. Appellant states that Cathey, Jr. does not reasonably support the allegedly inherent characteristics which "necessarily flows from the art and that one of skill in the art would recognize such."

8. The factual basis and the technical reasoning from which the rejection of claims (Cathey, Jr.,(US Pat. 5,096,536), was provided:

a. through pointing to Cathey, Jr.'s abstract which describes a method of producing a semiconductor structure, the method comprising the steps of plasma etching a surface of a substrate and transferring heat from the substrate, wherein the heat transfer capacity is increased which results in an improved semiconductor substrate being produced without deleterious chemical reaction;

b. through pointing to the title which describes the invention of Cathey, Jr. as being directed to a method of plasma etching semiconductor material with an apparatus; through pointing to Figure 1 of Cathey, Jr. which shows the apparatus used in the method of producing a semiconductor;

c.through pointing to the abstract that emphasizes the importance of controlling heat transfer utilizing a cooling gas to increase heat transfer across the substrate surface while the substrate is being etched in plasma etching reaction chamber; and

d.through disclosing three solutions for resolving uniformity of heat transfer, one solution being the utilization of a sole seal apparatus for controlling a helium gas supplied to etched substrate (Cathey, Jr. (col. 2, lines 33-45: claim limitations recited in instant claims 41-43).

9. Appellant argues the rejection of claim 28 under 35 U.S.C. 103(a) as being unpatentable over Cathey in view of Meyer et al (US Pat. 5089880, issued 1992) by asserting Cathey Jr does not "show or suggest transferring heat substantially uniformly across the substrate, the claimed invention is neither anticipated by, nor obvious over the applied references" and there is no motivation to combine.

10. In response the arguments presented with respect to Cathey in view of Meyer, it is the position of the examiner that Cathey, Jr does teach transferring heat substantially uniformly across the substrate and Meyer et al teaches a known range of thicknesses for semiconductor substrates which have been successfully been made, specifically from about 75-175 microns and one of ordinary skill in the art would have been motivated to utilize a substrate of a size that has been successfully used to produce a semiconductor etched substrate surface.

11. Appellant asserts that the rejection of claims 21 and 30 under 35 U.S.C. 103(a) as being unpatentable over Cathey, Jr., in view of Horiuchi et al (US Pat. 4,931,135) does not "show or suggest transferring heat substantially uniformly across the substrate, the claimed invention is neither anticipated by, nor obvious over the applied references."

12. In response the arguments presented with respect to Cathey in view of Horiuchi, it is the position of the examiner Cathey, Jr. does teach transferring heat substantially uniformly across the substrate through the utilization of a polymer seal (see col. 6, lines 38-40), and Horiuchi shows the use of polyimide (also known as Kapton or Capton), a the polymeric material that is readily used in

association with a plasma etching apparatus in a method of making an etched semiconductor substrate for more uniform heat transfer across the surface of the substrate.

13. Appellants argues that claims 38-39 rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps, are not incomplete because "[T]he "omitted" claim parts referred to by the Examiner, how to make a semiconductor or electronic device by the claimed etching method, are not described as essential anywhere in the specification and that the instant invention is directed to a "wafer etching method" and not circuit design.

14. It is the position of the examiner (See MPEP § 2172.0) that the specific materials and methods steps for making a semiconductor of claim 38, and the electronic device are not distinctly claimed. The rejection made of record stated the method of claim 21 only provides for the production of a single component part of a semiconductor, specifically a semiconductor substrate structure. What the semiconductor device is of claim 38 that is incorporated in to the electronic device of claim 39 is not clear, because the components of the semiconductor and the electronic device are not defined by any specific methods steps, and no specific arrangement of the components set forth in such a way as to clearly and distinctly claim methods of making a semiconductor and the method of making an electronic device because no components other than an etched substrate of any type is make, and no other components are defined to be in association with the substrate; the methods are not distinctly claimed. The etched substrate produced by the method of claim 21 is not a semiconductor or an electronic device.

New Grounds of Argument presented in Appeal Brief

15. Appellants asserts that the instant invention is distinguished from that of Cathey, Jr. by asserting that "the semiconductor wafer or substrate is sealed to the lower electrode with a single sealing ring having a thermal conductivity closely matched to that of the heat transfer gas", exemplified in the combination of a seal made of Kapton with heat transfer gas being helium.

16. It is the position of the examiner that the prior art discloses a method of etching or making a semiconductor substrate through the utilization of a single selected lower electrode with a single sealing O-ring, Appellants instantly claimed invention of claims 41-43, wherein the prior art taught the sole seal combination to include the heat transfer gas helium (see Cathey, Jr, col. 2, lines 25-45).

With respect to the new arguments made with respect to "matching the single sealing ring having a thermal conductivity closely matched to that of the heat transfer gas", it is the position of the examiner that none of the claims recite this combination of claim limitations argued, nor is the combination of Kapton (Kapton claim 30 dependent upon claim 21) with helium (helium claim 29, dependent upon claim 21) specifically claimed. Claim 30 (Kapton) does not depend from claim 29 (helium).

None of the claims recite structural or functional limitations that define "the thermal conductivity of the heat transfer gas and the seal may be matched to achieve a substantially uniform substrate temperature." The functional limitations "substantially uniform heat transfer" are argued based upon structural characteristics of thermal conductivity for heat transfer, but none

of the claims recite this requirement, nor define any specific type of matching of the gas with the seal selected for the plasma etching chamber. Appellant's arguments are not commensurate in scope with the pending claims.

17. Cathey, Jr. (US Patent 5,096,536) is asserted to be a reference applied as prior art based upon "a misconception of the difference between heat transfer from a substrate verses maintaining a substantially uniform temperature across a substrate.

18. In response to Appellant's assertion that Cathey, Jr. was applied due to a misconception of what Appellant's invention is, it is the position of the examiner that the claimed invention (claim 21) recites two steps, and Cathey, Jr. discloses the claimed methods steps in a method of making a semiconductor substrate structure and teaches that etched substrates can be used in the fabrication of a semiconductor (col. 1, lines 32-34).

As previously discussed Cathey, Jr sought to control coolant gas across the substrate to prevent deleterious chemical reaction effects on the substrate (see abstract, title, Figure 1, col. 2, lines 33-45). Uniform temperature across the substrate is accomplished with helium back cooling across the substrate (see Cathey, Jr. col. 1, lines 58-68 and col. 2, lines 25-31). The uniformity of temperature control is addressed (col. 4, lines 52-68) through filling voids between the substrate and the electrode, the voids defining a space that would not allow substantially uniform transfer of heat, and through filling the void with helium, substantially uniform heat transfer is accomplished and a more uniform temperature maintained for the substrate during the etching process.

Appellant's arguments directed to non-uniformity of the temperature "across the substrate" as compared with "away from" the substrate are not convincing because the method of Cathey, Jr teaches means and mechanisms that provide for greater environmental control through application of helium gas for back side cooling of the substrate which provides for increased uniformity of heat transfer across the substrate, as well as heat transfer away from the substrate (see Cathey, Jr.: col. 4, lines 52-68) and maintenance of a more uniform temperature across the substrate during the etching process.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Examiner Ginny Portner

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December 6, 2001

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